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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
P18752WO1		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE2003/002055	22/12/2003	
International Patent Classification (IPC) or national classification and IPC		
See Supplemental Box		
Applicant		
Telefonaktiebolaget LM Ericsson (publ) et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 13 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
03-06-2005	13-02-2006
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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

INTERNATIONAL PATENT CLASSIFICATION (IPC):

H04B 7/26 (2006.01)
H04Q 7/20 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-5, as originally filed/furnished
pages* 6-11 received by this Authority on 07-02-2006
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 12-18 received by this Authority on 07-02-2006
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1/4-4/4 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing *(specify)*: _____
- ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-51	YES
	Claims		NO
Inventive step (IS)	Claims	1-51	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-51	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a method and radio communication equipment for reducing interference from traffic channels for conventional communications on channels for opportunistic communications (HSDPA).

The problem to be solved by the invention concerns the interference on opportunistic channels caused by the control of conventional channels, especially when power control is applied on conventional channels.

The object of the invention is to separate physical channels for opportunistic communications and conventional communications.

Documents cited in the international search report:
D1: WO 03096571 A1
D2: US 2003203741 A1
D3: US 2003101274 A1
D4: EP 1351424 A2
D5: WO 03058988 A1
D6: US 2002181546 A1

Document D1, which is considered to represent the most relevant state of the art, discloses a method and system for allocating radio resources and transmission power to various radio channels having different characteristics (see claim 1) from which the subject-matter of claims 1, 26, and 51 differs in that transmission of these channels with different characteristics is performed separately on physically or partially separated channels and that the separation comprises

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

time-domain separation or frequency-domain separation without the use of different codes which renders it not obvious to a person skilled in the art.
The subject-matter of new claims 1, 26, and 51 is therefore novel (Article 33(2) PCT) and is considered to involve an inventive step.

The subject-matter of remaining claims 2-25, 27-50 are therefore also new and involve an inventive step.
The applicant also amended the description on pages 6-11 in order to increase clarity and therefore, the claims 3-6, 28-31 are now considered to be supported by the description.

Additional documents D2-D6 are considered to represent the general state of the art, and the invention in claims 1-51 is therefore not disclosed in any of these documents.

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mission power variation causes correspondingly varying interference to among others users of opportunistic communications. Such system generated varying interference reduces reliability of channel quality estimates important for opportunistic communications. It also implies requirements on more frequent channel estimates, loading the system, and overall reduced data rates on the opportunistic communications channels.

According to a preferred embodiment of the invention conventional and opportunistic communications are split in non-overlapping or minimally overlapping channels in one-dimensional domain, such as on a time-grid for TDM (Time Division Multiplex).

According to a second embodiment, the different communications are split in two-dimensional domain, such as time-frequency for OFDM (Orthogonal Frequency Division Multiplex).

In a further embodiment the channels are separated in code domain, to be used as one-dimensional separation or combined with one or more other one- or plural-dimensional domain separations to minimize cross-characteristics interference. Example codes are LAS (Large Area Synchronized) spreading codes. The invention is applicable in general to separation in arbitrary dimensional domain, where the plural-dimensional domain includes time, frequency or code.

Preferably, according to the invention interference in terms of signal to interference ratio is minimized. However, most interference related quality measures, such as those mentioned on p. 2, could be applied.

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In an example mode of the invention, a first of at least two traffic categories of communications is transmitted with stationary or quasi-stationary transmission power level.

In another example mode of the invention, the quasi-stationary transmission power level is varying slower than the lowest speed of communications variations of the traffic of the first category.

In a further example mode of the invention, difference in time scale between at least two traffic categories is at least one order of magnitude.

A particular problem entails from neighboring cells, where conventional communications of one cell may interfere with opportunistic communications of another cell. To minimize the risk of interference between cells where demand for conventional and opportunistic communications differ between cells, and hence some overlap will occur if all channels are occupied, different modes of the invention allocates channels such as to minimize use of common resources considering a limited number of domain dimensions.

Figure 1 depicts two radio communications cells «Cell 1», «Cell 2», each comprising a base station «BS 1», «BS 2», for both conventional and opportunistic radio communications according to the invention. Depending on, among other things, geographical distance and terrain between neighboring radio communications cells «Cell 1», «Cell 2» radio emissions from the respective base stations antennas may interfere with (desired) communications of the neighboring cell.

Figure 2 illustrates one-dimensional domain time-overlap for TDM. In a first radio communications cell «Cell 1», three time slots «C11», «C12», «C13» out of eight «C11», «C12», «C13», «O11», «O12», «O13», «O14», «O15» are allocated for

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conventional communications and five time slots «011», «012», «013», «014», «015» are allocated for opportunistic communications. In a second cell «Cell 2» five time slots «C21», «C22», «C23», «C24», «C25» are allocated for conventional communications and three «021», «022», «023» for opportunistic communications. As the fractional allocation of conventional and opportunistic communications is different for cells 1 and 2 and all time slots are allocated, opportunistic communications time-slots in cell 2 cannot be completely separated from conventional communications time-slots of cell 2 in a one-dimensional domain such as time-domain. The interference in this example allocation is minimized when the number of overlapping time slots of different communications in the two cells is minimized. In the figure, two time-slots of opportunistic communications «011», «012» of cell 1 overlap in time with two time-slots of conventional communications «C24», «C25» of cell 2.

Figure 3 shows separation of conventional communications and opportunistic communications in two-dimensional time-frequency domain. In a first cell «Cell 1» of a cellular radio communications system a number of time-frequency slots «125» are allocated for conventional communications and a number of slots allocated for opportunistic communications «134», «144», «152», «162». In a second radio cell «Cell 2» the allocation is somewhat different due to different demand on conventional and opportunistic communications channels, respectively. A time-frequency slot «225», for which corresponding slot in cell 1 «125» was allocated for conventional communications, is allocated for opportunistic communications and four time-frequency slots «234», «244», «252», «262», with correspondences «134», «144», «152», «162» allocated for opportunistic communications in cell 1, are allocated for conventional communications. For both slot allocations of figure 3 the time-frequency range is identical.

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Obviously five slots «225», «234», «244», «252», «262» of cell 2 overlap in time and frequency with «125», «134», «144», «152», «162» of cell 1. The number of overlapping time-frequency slots may be reduced to three by e.g. swapping allocations of two slots of cell 1 for which cell 2 has a different allocation. If, e.g., slot «125» were allocated for opportunistic communications and slot «134» allocated for conventional communications the allocations would be of same types for both radio cells «Cell 1», «Cell 2» for all by three time-slots «144», «152», «162», «244», «252», «262».

The two-dimensional example above illustrates that interference effect may be reduced not only by minimizing number of overlapping slots, but also by careful selection of which communications should be subject to interference from neighbor-cell slots with communications of different characteristics. Also, instead of reducing number of overlapping slots, a "sufficiently small" interference could be accepted an approximate minimum when further minimization would yield no or small perceived quality improvement. As mentioned above, the criteria to minimize, for true minimum or satisfaction, could be e.g. signal to interference ratio, SIR, or any of the criteria mentioned on p. 2 such as carrier to interference ratio, CIR.

In one mode of the invention it is adapted for combination with various well-known means of controlling the resource allocation in a dynamic manner incorporating centralized or decentralized/distributed resource allocation. The adaptation time schedule on which the resources are allocated may be long or short term. For the short term, resource allocation can change from call to call, or even adapt to instantaneous channel conditions, whereas the long term allocation may change, on a diurnal basis, e.g. between peak hours and off-peak hours. The

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resource allocation can also be of static nature defined at system initiation.

In a further example mode of the invention, a category of communications is transmitted with channel adaptive data rate control.

Figure 4 schematically illustrates equipment «Equipment» according to the invention. A number of information sources «Source 1», «Source 2», ..., «Source n» comprising, e.g., speech or data are connected 1, 2, ..., n to the equipment which may be fixed radio equipment, e.g. equipment of a radio access network, or mobile equipment, e.g. user equipment. For equipment of a radio access network, the sources may be connected through a gateway (not illustrated) or other network equipment, the radio access network equipment separating and transmitting conventional and opportunistic «Opportunistic» communications over N conventional slots/channels «Conventional» and M opportunistic slots/channels «Opportunistic», for non-negative integers N and M, as described in relation to figures 2 and 3.

For mobile equipment one or more sources «Source 1», «Source 2», ..., «Source n» of figure 4 may be related to equipment integrated within, e.g., a mobile station, such as stored data or applications, or be connected to, e.g., a mobile station essentially operating as an interface for information transfer. In a preferred mode of the invention, the mobile equipment receives information from a network controller related to particular allocation of the traffic channels on a control channel (not illustrated).

The network allocation control can be centralized, decentralized or distributed. With centralized control the network controller is responsible for channel allocation within a wide area, such as for a switching center or access point to the

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Internet, with a plurality of base stations «BS 1», «BS 2». In a decentralized realization local network controllers are responsible for channel allocation, that nevertheless is coordinated between neighboring areas, for which local network controllers are responsible. In a distributed system, the local controllers have limited responsibility and assist one or more central controller to achieve the final allocation. Decentralized or distributed allocation control is not restricted to radio access network controllers but can include mobile equipment.

The invention is not intended to be limited only to the embodiments described in detail above. Changes and modifications may be made without departing from the invention. It covers all modifications within the scope of the following claims.

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CLAIMS

1. A method of communications of traffic with different characteristics wherein traffic from at least two information sources is divided into two or more categories including a first and a second category for transfer with different characteristics, the method characterized in that the traffic for the transfer with different characteristics are transmitted on physically wholly or partially separated channels, the separation comprising time-domain separation or frequency-domain separation.

2. The method according to claim 1 characterized in that the different characteristics of transfer comprises different time scale of power control adjustments.

3. The method according to claim 2 characterized in that there is a difference in time scale between at least two categories that is at least one order of magnitude.

4. The method according to any of claims 1-3 characterized in that the first category of communications is transmitted with stationary or quasi-stationary transmission power level.

5. The method according to claim 4 characterized in that the quasi-stationary transmission power level is varying slower than the lowest speed of communications variations of the traffic of the first category.

6. The method according to any of claims 1-3 characterized in that the first category of communications is transmitted with channel adaptive data rate control.

7. The method according to any of claims 1-3 characterized in that at least one of the categories of communications comprises opportunistic communications.

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8. The method according to any of claims 1-3 characterized in that the second category of communications is transmitted with power level adapted to counteract fading.

9. The method according to any of claims 1-3 characterized in that at least one of the categories of communications comprises conventional communications.

10. The method according to claim 9 characterized in that the conventional communications comprise circuit switched communications.

11. The method according to claim 10 characterized in that the circuit switched communications comprise voice communications.

12. The method according to claim 9 characterized in that the conventional communications comprise communications with real-time requirements.

13. The method according to any of claims 1-11 characterized in that the communications are separated in one-dimensional domain.

14. The method according to claim 13 characterized in that the one-dimensional domain is time domain.

15. The method according to claim 13 characterized in that the one-dimensional domain is frequency domain.

16. The method according to claim 13 characterized in that the one-dimensional domain is code domain.

17. The method according to any of claims 1-11 characterized in that the communications are separated in two-dimensional domain.

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18. The method according to claim 17 characterized in that the two-dimensional domain is time-frequency domain.

19. The method according to claim 17 characterized in that the two-dimensional domain is time-code domain.

20. The method according to claim 17 characterized in that the two-dimensional domain is frequency-code domain.

21. The method according to any of claim 1-11 characterized in that the communications are separated in more than two-dimensional domain.

22. The method according to claim 21 characterized in that the more than two-dimensional domain includes time, frequency or code domain.

23. The method according to any of claims 1-22 characterized in that when applied to different cells of a cellular radio communications system, neighboring cells transmit on channels of separation minimizing interference between the neighboring cells and the differently characterized communications.

24. The method according to claim 23 characterized in that the separation minimizes number of time slots, frequency slots or time-frequency slots of communications with different characteristics in the different cells.

25. The method according to claim 23 characterized in that the separation maximizes signal to interference ratio or carrier to interference ratio of time slots, frequency slots or time-frequency slots, if any, of communications with different characteristics in the different cells.

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26. A radio communications equipment of communications with different characteristics, the equipment c h a r a c t e r i z e d b y processing circuitry ~~allocating~~ traffic transmissions of the differently characterized communications to physically wholly or partially separated channels, the separation comprising time-domain separation or frequency-domain separation.

27. The radio communications equipment according to claim 26 c h a r a c t e r i z e d i n that the different characteristics of transfer comprises different time scale of power control adjustments.

28. The radio communications equipment according to claim 27 c h a r a c t e r i z e d i n that there is a difference in time scale between at least two categories that is at least one order of magnitude.

29. The radio communications system according to any of claims 26-28 c h a r a c t e r i z e d i n that a first category of communications is transmitted with stationary or quasi-stationary transmission power level.

30. The radio communications system according to claim 29 c h a r a c t e r i z e d i n that the quasi-stationary transmission power level is varying slower than the lowest speed of communications variations of the traffic of the first category.

31. The radio communications equipment according to any of claims 26-28 c h a r a c t e r i z e d b y the processing circuitry comprising channel adaptive data rate control means controlling transmissions of the first category of communications.

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32. The radio communications equipment according to claim 26 characterized in that at least one of the communications is opportunistic communications.

33. The method according to any of claims 26-28 characterized in that a second category of communications is transmitted with power level adapted to counteract fading.

34. The radio communications equipment according to claim 32 characterized in that at least one of the communications is conventional communications.

35. The radio communications equipment according to claim 34 characterized in that the conventional communications comprise circuit switched communications.

36. The radio communications equipment according to claim 35 characterized in that the circuit switched communications comprise voice communications.

37. The radio communications equipment according to claim 34 characterized in that the conventional communications comprise communications with real-time requirements.

38. The radio communications equipment according to any of claims 26-36 characterized by the processing circuitry separating communications in one-dimensional domain.

39. The radio communications equipment according to claim 38 characterized in that the one-dimensional domain is time domain.

40. The radio communications equipment according to claim 38 characterized in that the one-dimensional domain is frequency domain.

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41. The radio communications equipment according to claim 38 characterized in that the one-dimensional domain is code domain.

42. The radio communications equipment according to any of claims 26-36 characterized by the processing circuitry separating communications in two-dimensional domain.

43. The radio communications equipment according to claim 42 characterized in that the two-dimensional domain is time-frequency domain.

44. The radio communications equipment according to claim 42 characterized in that the two-dimensional domain is time-code domain.

45. The radio communications equipment according to claim 42 characterized in that the two-dimensional domain is frequency-code domain.

46. The radio communications equipment according to any of claim 26-36 characterized by the processing circuitry separating communications in more than two-dimensional domain.

47. The radio communications equipment according to claim 21 characterized in that the more than two-dimensional domain includes time, frequency or code domain.

48. A cellular radio communications system comprising two or more cells and radio communications equipment according to any of claims 26-47, the system characterized by processing circuitry allocating traffic of different characteristics of different cells by which allocation interference between differently characterized communications of neighboring cells is minimized.

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49. The radio communications system according to claim 48 characterized by the processing circuitry minimizing number of time slots, frequency slots or time-frequency slots of communications with different characteristics in the different cells.

50. The radio communications system according to claim 48 characterized by the processing circuitry maximizing signal to interference ratio or carrier to interference ratio of time slots, frequency slots or time-frequency slots, if any, of communications with different characteristics in the different cells.

51. A communications system characterized by means for carrying out the method in any of claims 1–25.